भारतीय मानक
Indian Standard

IS 17796 : 2023

गैस्केट और पैकिंग — संपीडित नॉन-एस्बेस्टस रेशा (सी एन ए एफ) आधारित गैस्केट संधि शीट — विशिष्टि

Gasket and Packings — Compressed Non-Asbestos Fibre (CNAF) Based Gasket Jointing Sheets — Specification

ICS 23.040.80

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Gasket and Packings Sectional Committee, MED 30

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards after the draft finalized by the Gasket and Packing Sectional Committee had been approved by the Mechanical Engineering Division Council.

Compressed non-asbestos fibre based gasket jointing sheets are used for filling up the space between two or more mating surfaces, generally to prevent leakage from or into the joint objects while under compression.

The composition of the Committee responsible for the formulation of this standard is given in Annex H.

For the purpose of deciding whether a particular requirement of this standard is compiled with the final value, observed or calculated, expressing the rules of the test or analysis shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GASKET AND PACKINGS — COMPRESSED NON-ASBESTOS FIBRE (CNAF) BASED GASKET JOINTING SHEETS — SPECIFICATION

1 SCOPE

This standard covers the requirements and testing of elastomer bonded compressed non-asbestos fiber (CNAF) based gasket jointing sheets.

Grades X, Y, and Z for general industrial use are covered in this standard.

2 REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of the standards. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
6210 : 1979	Method of test for stress relaxation of gasket material (*first revision*)
4905 : 2015/ ISO 24153 : 2009	Random sampling and randomization procedures (*first revision*)

3 TERMINOLOGY

For the purpose of this standard, the following terms and definitions shall apply.

3.1 Compressed Non-Asbestos Fiber (CNAF) based Gasket Jointing Sheets — Elastomer bonded solid run single-ply material, manufactured by hot calendaring process and supplied in sheets, from which required shapes can be cut and used for the purpose of sealing mating faces of components from the ingress or egress of fluids and gases.

3.2 Manufacturing Run — Amount of all jointings of one grade and thickness in units of a maximum 5 tons.

3.3 Batch of Material — Single mix of ingredients that are uniquely identified and traceable.

4 GRADES AND MATERIALS

4.1 Grades

Grades of CNAF gasket jointing sheets covered in this standard are given in Table 1.

Table 1 Grades of CNAF Gasket Jointings

(*Clause* 4.1)

Sl No. (1)	Grade (2)	Application (3)
i)	X	Suitable for water, steam, and gases at temperatures up to 250 °C and for oil, solvent, and inert liquids at temperature up to 400 °C
ii)	Y	Suitable for water, steam, and gases at temperatures up to 200 °C and for oil, solvent, and inert liquids at temperature up to 300 °C
iii)	Z	Suitable for water, steam, gases, and oil for maximum temperature up to 150 °C

4.2 Material

CNAF gasket jointing sheet material shall consist of non-asbestos inorganic/organic fibers and inorganic fillers bonded with a suitable elastomer or blend of elastomers, and shall be manufactured by the hot calendaring process to form sheets of various dimensions. The mix of ingredients shall be uniformly dispersed throughout the jointing sheet.

4.3 Reinforcement

Except acid resistant jointing, all grades shall be available with or without wire mesh reinforcement.

5 FINISH

CNAF gasket jointing sheets of all grades shall be solid run (not laminated, of uniform texture, smooth on both sides, and free from irregularities such as blisters, tears, and lumps).

The surfaces may be treated with an acceptable release agent, for example, graphite or PTFE (Polytetrafluoroethylene).

6 THICKNESS

6.1 Nominal Thickness

The recommended nominal thickness of all grades of CNAF jointing shall be one of the following:

0.40 mm, 0.50 mm, 0.75 mm, 1.00 mm, 1.50 mm, 2.00 mm, and 3.00 mm.

Other thicknesses between 0.30 mm and 6.00 mm may be produced if required.

NOTE — For any grade of material the compressive strength at elevated temperature decreases with increasing thickness.

6.2 Thickness Tolerance

The maximum permissible variation A in thickness of any sheet from the nominal thickness and the maximum permissible variation B in thickness between any two points not more than 250 mm apart shall be as given in Table 2.

6.3 Dimensions

The length, width, and tolerances of the CNAF jointing sheet shall be agreed to between the manufacturer and the purchaser.

7 TESTS

7.1 Samples

A sample shall be selected from each manufacturing run of CNAF jointings of Grades X, Y, and Z. A sample or samples including those treated with a release agent, for example graphite/PTFE or any other, where appropriate, should be sufficient to provide the test pieces for one complete series of tests as specified in this clause.

Each grade of CNAF jointing sheets shall be tested in accordance with **7.2** to **7.9**.

7.2 Density

A test piece of 100 mm × 100 mm shall be weighed correctly to 0.1 g and its thickness ascertained according to **6.1** and **6.2**. The mass of the test piece in grams divided by its volume in cubic centimeters gives the density which shall be between 1.60 and 2.20 g/cm^3 for Grade X, Y, and Z.

7.3 Stress Relaxation

CNAF jointings of Grades X, Y, and Z shall be tested for resistance to creep at high temperatures. The apparatus to be used for the preparation of the test piece and the method of the test shall be as described in IS 6210.

In the case of 1.50 mm thick jointing sheets, the test piece shall be cut from the material under supply. In the case of other thicknesses, the test piece shall be cut from 1.50 mm thick jointing sheet which shall be produced from the same batch.

The residual stress determined shall not be less than the following:

a) 25 MPa for grades X at 300 °C;
b) 22 MPa for grades Y at 300 °C; and
c) 17.5 MPa for grades Z at 175 °C.

7.4 Flexibility

When tested in accordance with Annex A in the supplied condition, all grades shall not crack or delaminate.

7.5 Compressibility and Recovery Test

The compressibility and recovery shall be determined in accordance with Annex B.

7.5.1 CNAF jointing sheets of 1.50 mm nominal thickness and above shall show a depth of the impression which shall be expressed as a percentage of the original thickness under preload. The amount recovered after releasing the major load is the recovery, which is expressed as the recovery percentage of the original thickness under preload. In the case of other thicknesses, the test piece shall be cut from 1.50 mm thick jointing sheet which shall be produced from the same batch by the manufacturer.

7.5.2 A minimum of three test specimens shall be subjected to this test and results averaged. Compressibility of the material shall be minimum of 6 percent and the recovery shall be minimum of 40 percent for grades X, Y, and Z.

Table 2 Thickness Tolerance of CNAF Gasket Jointing Sheet

(*Clause* 6.2)

Sl No. (1)	Nominal Thickness (mm) (2)	Variation A (mm) (3)	Variation B (mm) (4)
i)	Up to and including 0.5	± 0.05	± 0.05
ii)	Over 0.5, up to and including 1.0	± 0.10	± 0.10
iii)	Over 1.0, up to and including 2.0	± 0.15	± 0.10
iv)	Over 2.0, up to and including 3.0	± 0.20	± 0.15
v)	Over 3.0, up to and including 4.0	± 0.30	± 0.20
vi)	Over 4.0	± 0.40	± 0.20

7.6 Resistance to Fluids

7.6.1 *Test Fluid 1 Absorption*

When tested for test fluid 1 absorption in accordance with Annex C, CNAF gasket jointings of grades X, Y, and Z shall meet the requirements shown in Table 3.

After immersion, the samples shall not crack or delaminate when tested in accordance with Annex C nor shall their surfaces show signs of tackiness, but discoloration and surface blistering is permitted.

Unless otherwise specified, test fluid 1, of the following characteristics is used:

a) Aniline point 69.5 ± 1 °C;
b) Kinematic viscosity 31.9 to 34.1 cSt (measured at 37.8 °C); and
c) Flash point 162.7 °C.

7.6.2 *Test Fluid 2 Absorption*

When tested for test fluid 2 absorption in accordance with Annex C, CNAF gasket jointings of grades X, Y, and Z shall meet the requirements shown in Table 3.

After immersion, the samples shall not crack or delaminate when tested in accordance with Annex C nor shall their surfaces show signs of tackiness, but discoloration and surface blistering is permitted.

Test fluid 2 is a mixture of 75 parts by volume of pure iso-octane and 25 parts by volume of pure toluene.

7.6.3 *Water Absorption*

When tested for water absorption in accordance with Annex D, CNAF gasket jointings of grades X, Y, and Z shall meet the requirements shown in Table 3.

Table 3 Maximum Percentage Increase in Thickness and Mass

(*Clause* 7.6.1, 7.6.2, *and* 7.6.3)

Sl No.	**Grades**	**Percentage Increase**	
		Thickness	**Mass**
(1)	(2)	(3)	(4)
Test Fluid 1 Absorption Test (5 h at 150 ºC) – Cooling Time - 30 min			
i)	X and Y	20 upto 0.75 mm 10 above 0.75 mm	NA
ii)	Z	20, *Max*	15, *Max*
Test Fluid 2 Absorption (5 h at 20 to 30 ºC - Thickness and 5 h at 20 to 30 ºC – Mass) Cooling Time - 20 s			
iii)	X and Y	10, *Max*	NA
iv)	Z	15, *Max*	15, *Max*
Water Absorption (5 h at 100 ºC - Thickness and 5 h at 20 to 30 ºC – Mass) Cooling Time - 15 min			
v)	X and Y	15, *Max*	NA
vi)	Z	15, *Max*	15, *Max*

7.6.4 The percentage increase in thickness and mass shall not exceed the values given in Table 3.

7.7 Gas Permeability

When determined in accordance with Annex E, the leakage shall not exceed the following:

For grades X, Y, and Z : 1 ml/min.

For wire reinforced materials : 3 ml/min.

7.8 Tensile Strength

When tested in accordance with Annex F, CNAF jointings of grades X, Y, and Z with a nominal thickness of 1.5 mm shall be tested for tensile strength at room temperature.

The tensile strength for grades X, Y, and Z shall not be less than the following:

a) 10 MPa, *Min* for Grade X;
b) 10 MPa, *Min* for Grade Y; and
c) 8 MPa, *Min* for Grade Z.

7.9 Loss on Ignition

The loss on ignition shall be as follows:

For Grades X and Y : 28 percent, *Max*

For Grade Z : 40 percent, *Max*

It shall be determined by the method as described in Annex G.

8 SCALE OF SAMPLING AND CRITERIA FOR CONFORMITY

8.1 Scale of Sampling

8.1.1 *Lot*

In any consignment, all the pieces or rolls of CNAF gasket jointings of the same grade and dimensions manufactured under essentially similar conditions of production shall be grouped to constitute a lot.

For ascertaining the conformity of the lot to the requirements of this specification, tests shall be carried out from each lot separately. The number of sheets to be selected at random for this purpose shall be according to Table 4. To ensure the randomness of the selection, IS 4905/ISO 24153 may be used.

8.1.2 *Number of Tests and Criteria for Conformity*

8.1.2.1 The number of sheets of CNAF jointings selected according to **8.1.1** shall be examined for dimensions. If the number of sheets found not in conformity with the specified requirements is less than or equal to the corresponding number given in column 4 of Table 4, the lot shall be declared conforming to the requirements for dimensions.

Table 4 Sample Size and Criteria for Conformity

(*Clauses* 8.1.1, 8.1.2.1, *and* 8.1.2.2)

Sl No.	No. of Sheets in the Lot	For Dimensions		Sample Size for Tensile Strength, Compression and Recovery Test, Density, and Other Characteristics
		Sample Size	Permissible Defects	
(1)	(2)	(3)	(4)	(5)
i)	Up to 15	2	0	2
ii)	16 to 25	3	0	2
iii)	26 to 50	5	0	2
iv)	51 to 100	8	0	2
v)	101 and above	13	1	3

NOTE — This ensures that lots containing 2.5 percent or less defective will be accepted in most of the items.

In case of those lots which have been found satisfactory according to **8.1.1**, a number of sheets or rolls equivalent to the sample size indicated in column 5 of Table 4 shall be selected and subjected to the tests for tensile strength, compression, and recovery test, density, and other characteristics.

8.1.2.2 If any sample fails to comply with the requirements related to any test as indicated in Table 4, double the number of samples shall be selected from the same manufacturing run for retesting. If either of the retest samples fails the test the whole manufacturing run of material shall be deemed not to comply with this Indian Standard.

8.1.2.3 The lot shall be declared conforming to the above requirements if all the test specimens/retest specimens if any, satisfy the relevant requirements.

9 MARKING

9.1 CNAF jointings shall be marked with the following information:

a) Grade;
b) Month and year of manufacture; and
c) Manufacturer’s name on each sheet.

9.2 BIS Certification Marking

The product conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed there under, and the product may be marked with the Standard Mark.

9.3 CNAF jointing is marked with the manufacturer’s identification mark. This shall be indelibly marked on every 300 mm × 300 mm of the jointing sheet.

10 PACKING

CNAF jointings may be supplied flat, suitably packed to prevent damage, or maybe supplied in rolls.

11 INFORMATION TO BE SUPPLIED BY THE PURCHASER

The following information to be supplied by the purchaser shall be fully documented. For compliances with the standard both the definitive requirements specified throughout the standard and the following documented items shall be satisfied:

a) The number of this Indian Standard (IS No. ______);
b) The grade of jointing required (*see* **1**);
c) The thickness required (*see* **6.1**);
d) The dimensions of sheets required;
e) The number of sheets required;
f) The wire mesh requirement if any. If so, specify the wire material diameter and mesh size (*see* **4.3**);
g) The manufacturer's identification mark (*see* **9.1**); and
h) The requirement of release agent treatment on single side or both sides of the surfaces, for example, PTFE, graphite, etc (*see* **5**).

ANNEX A

(*Clause* 7.4)

METHOD FOR FLEXIBILITY TEST

A-1 PRINCIPLE

This test evaluates the ability of the material to be bent without cracking, delamination, or other signs of distress.

A-2 APPARATUS

Mandrel with a diameter of 12 times the nominal thickness of the material.

A-3 TEST PIECE

The test piece shall consist of a strip 12.5 mm wide and 150 mm long, cut with its longitudinal axis at right angles to the direction of rolling of the sheet.

A-4 TEST PROCEDURE

A-4.1 Bend the test piece at room temperature, through an angle of 180° around and normal to the axis of the test mandrel, taking no more than 2 s. The force used shall be just sufficient to hold the test piece in contact with the mandrel.

A-4.2 Hold the test piece in the bent position around the mandrel for 10 s and examine it visually.

A-4.3 Repeat **A-4.1** and **A-4.2** on different sections of the strip but with the other face of the material in contact with the mandrel.

ANNEX B

(*Clause* 7.5)

METHOD OF TEST FOR COMPRESSIBILITY AND RECOVERY

B-1 PRINCIPLE

The depth of impression in the material caused by an indenter is measured under a constant load and expressed as a percentage of the original thickness under preload. Compressibility percent is measured when a major load is applied and the recovery percent is measured when the major load is released. This test can be conducted either by test method 1 or test method 2.

B-2 CONDITIONING

Condition the test pieces by the following controlled heating and cooling. Heat the test pieces for at least 1 h in an oven maintained at 100 ± 2 °C. Remove and place the test pieces in a desiccator containing anhydrous calcium chloride for a minimum of 1 h to cool to ambient temperature.

B-3 TEST PIECE

Cut from the sample a minimum of three test pieces each in a form of a square having a minimum of 50 mm². Each test piece consisting of a single thickness or a number of superimposed thicknesses to give a minimum nominal thickness of 1.50 mm and conditioned as specified in **B-2**. After cooling, measure the thickness of each test piece (T).

B-4 TEST METHOD 1

B-4.1 Test Equipment

The test shall be conducted on a suitable compression testing machine in which the load is applied through an axial loading device similar to that shown in Fig. 1.

a) A hardened and ground steel lower platen with a minimum diameter of 50 mm.

b) A cylindrical indenter 25 $\pm$ 0.2 mm in diameter shall be made of steel with a tensile strength of not less than 620 MPa. Both ends of this indenter shall be ground accurately parallel to each other as also shall be the loading faces of the platen.

B-4.2 Test Procedure

The thickness of the test piece, at different stages of the test, shall be measured by means of two dial indicators, graduated in hundredths of a millimeter, which together with the indicator shall be rigidly attached to the upper loading platen. The spindles of the dial indicator shall rest on the lower platen.

It is essential that the dial indenters do not indicate any relative movement between the top and bottom platens during the application of full force 15.6 kN through the indenter without a test piece in position, in order to check that there is no distortion in the apparatus.

Place one test piece between the indenter and the bottom platen and load initially to 1 kN (equivalent to stress of 2.0 MPa). This preload shall be maintained for 15 s and note the average reading on the dial indicators to obtain the thickness under preload (T_1).

Raise the load in 1 min to 15.6 kN, maintain this load for a further 30 s and note the average reading on the dial indicators to obtain the thickness under the major load (T_2).

The major load shall then be removed and the preload of 1 kN maintained for 1 min and the reading of the dial indicator noted (T_3).

B-5 TEST METHOD 2

B-5.1 Test Equipment

The test shall be conducted on a suitable compression testing machine in which the load is applied through an axial loading device similar to that shown in Fig. 1 with the following requirement:

a) A hardened and ground steel lower platen with a minimum diameter of 31.70 mm; and

b) A cylindrical indenter 6.4 ± 0.025 mm in diameter shall be made of steel with a tensile strength of not less than 620 MPa (MN/m^2). Both ends of this indenter shall be ground accurately parallel to each other as also shall be the loading faces of the platen.

B-5.2 Test Procedure

The thickness of the test piece, at different stages of the test, shall be measured by means of dial indicator in the center of indenter, graduated in hundredths of a millimeter, which together with the indicator shall be rigidly attached to the upper loading platen. The spindles of the dial indicator shall rest on the lower platen.

It is essential that the dial indenters do not indicate any relative movement between the top and bottom platens during the application of full force 1 090 N through the indenter without a test piece in position, to check that there is no distortion in the apparatus.

Place one test piece between the indenter and the bottom platen and load initially to 22.2 N. This pre-load shall be maintained for 15 s and note the dial gauge reading on the dial indicator to obtain the thickness under preload (T_1).

Immediately apply the measured load in a slow uniform manner so that the total load is attained within 10 s. Maintain the total load for 1 min and record the thickness of the specimen (T_2).

The measured load shall then be removed and the pre-load of 22.2 N maintained for one minute and the reading of the dial indicator noted (T_3).

B-6 CALCULATION

Calculate the difference between the indicating gauge(s) reading for each test and express this depth of impression as a percentage of the preloaded thickness of the material.

$$\text{Compressibility, percentage} = \frac{T_1 - T_2}{T_1} \times 100$$

$$\text{Recovery, percentage} = \frac{T_3 - T_2}{T_1 - T_2} \times 100$$

Repeat the test for the other two test pieces. The average of the test results obtained on the three test pieces shall be the percentage compressibility and recovery of the material respectively.

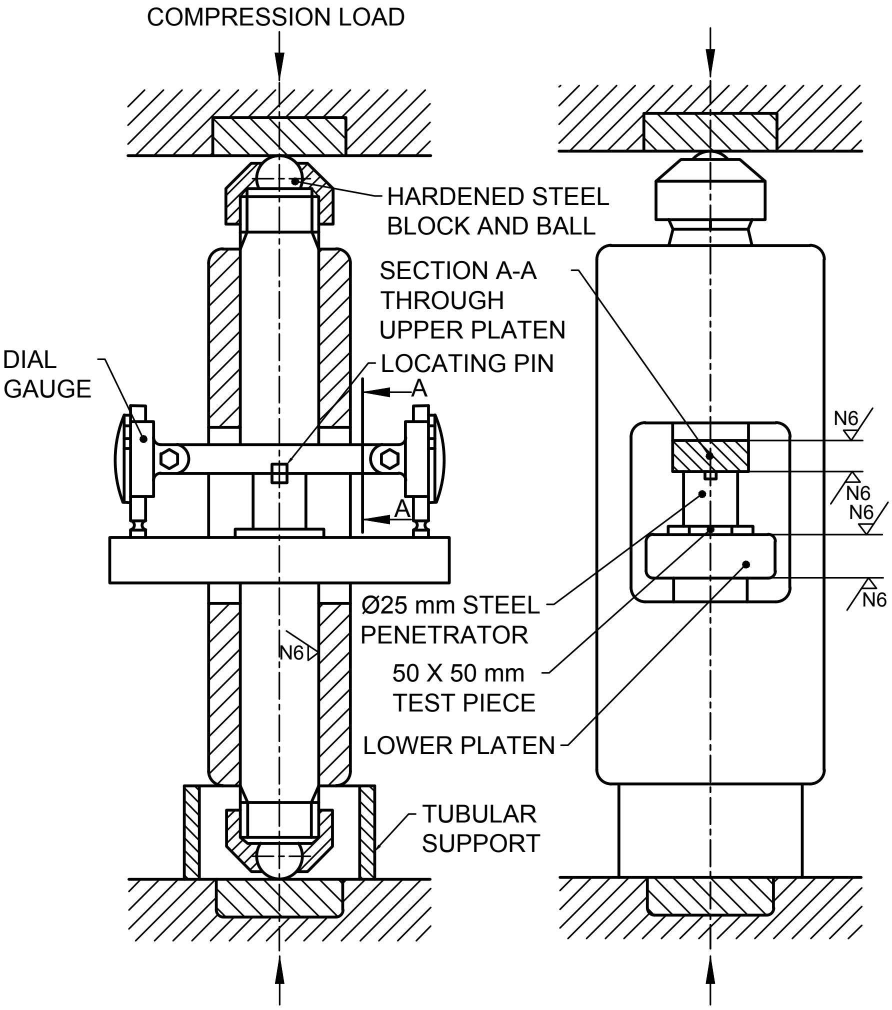


FIG. 1 AXIAL LOADING SHACKLE FOR COMPRESSION TEST

ANNEX C

(*Clauses* 7.6.1 *and* 7.6.2)

METHOD OF TEST FOR TEST FLUID 1 AND TEST FLUID 2 ABSORPTION

C-1 PRINCIPLE

Measuring the thickness and/or weight of the conditioned test pieces before and after immersion in the test fluids gives a gain in thickness and/or weight from which the absorption can be determined as a percentage of the original value.

C-2 CONDITIONING

Condition the test pieces in accordance with Annex B, **B-2**.

C-3 APPARATUS

C-3.1 Oven, capable of maintaining temperatures upto 150 ± 2 ºC.

C-3.2 Desiccator, containing anhydrous calcium chloride/dry silica gel.

C-3.3 Thickness measuring instrument, in accordance with **6.2**.

C-3.4 The covered vessel for water tests, maintained at 100 °C.

C-3.5 Weighing scale, capable of an accuracy of ± 0.001 gm.

C-3.6 Test fluids as follows:

a) For all grades, test fluid 1 as per characteristics referred in **7.6.1**;
b) For all grades, test fluid 2 as referred in **7.6.2**; and
c) For all grades, demineralized water.

C-4 TEST PIECES

The test shall be carried out on three test pieces each for immersion in test fluid 1 and test fluid 2 as described in **7.6.1** and **7.6.2**. The test pieces shall be cleanly cut to size 50 mm × 25 mm. The test pieces may vary in dimensions by ± 0.15 mm and conditioned as described in **C-2**.

C-5 TEST PROCEDURE

C-5.1 Test Fluid 1 Absorption

Weigh each test piece in the air to the nearest 0.001 g as M_1. Determine the thickness T_1 of each test piece by taking a sufficient number of readings to provide a reliable average value. Place three test pieces in a test tube having an outside diameter of 38 mm and an overall length of 300 ml of the test liquid. Glass beads shall be used in the liquid as a bumper and to separate the specimens. After treating three test pieces in test fluid 1 for 5 h at 150 ± 2 °C remove the test pieces from the test liquid.

Test pieces that have been treated in test fluid 1 for 5 h at 150 °C, shall be cooled to room temperature by transferring the test pieces to a cool clean portion of the same test liquid for 30 to 60 min. Dip the specimens quickly into acetone, blot lightly with filter paper free of lint and foreign material. Immediately weigh the test pieces on a weighing balance and determine the mass after test M_2. Measure the thickness of each test piece as before to obtain a reliable average T_2.

C-5.2 Test Fluid 2 Absorption

Determine the thickness T_1 of each test piece by taking a sufficient number of readings to provide a reliable average value. Place three test pieces in a test tube having an outside diameter of 38 mm and an overall length of 300 ml of the test liquid.

Glass beads shall be used in the liquid as a bumper and to separate the specimens. After treating three test pieces in test fluid 2 for 5 h at 20 to 30 °C, remove the test pieces from the test liquids and determine the thickness after the test as T_2.

In order to determine the increase in mass, weigh each test piece in the air to the nearest milligram M_1. Place three test pieces in a test tube having an outside diameter of 38 mm and an overall length of 300 ml of the test liquid. Glass beads shall be used in the liquid as a bumper and to separate the specimens. After treating three test pieces in test fluid 2 for 5 h at 20 to 30 °C, remove the test pieces from the test liquids and determine the mass after the test as M_2.

C-5.2 Percentage increase in thickness:

$$\frac{T_2 - T_1}{T_1} \times 100$$

Percentage increase in mass:

$$\frac{M_2 - M_1}{M_1} \times 100$$

NOTE — These tests should only be done for the material of thickness of 0.75 mm up to and including 3.00 mm owing to the practical difficulty of making satisfactory and reliable measurements.

ANNEX D

(*Clause* 7.6.3)

METHOD OF TEST FOR WATER ABSORPTION

D-1 PRINCIPLE

Measuring the thickness and/or weight of the conditioned test pieces before and after immersion in the test fluids gives a gain in thickness and/or weight from which the absorption can be determined as a percentage of the original value.

D-2 CONDITIONING

Condition the test pieces in accordance with **B-2**.

D-3 APPARATUS

See **C-3** for details of apparatus.

D-4 TEST PIECES

Test piece of size 50 mm × 25 mm shall be cut from the sheet and conditioned as described in **D-1**.

D-5 TEST PROCEDURE

D-5.1 Determine the thickness (T_1) of each test piece by taking a sufficient number of readings to provide a reliable average value. Place three test pieces in a test tube having an outside diameter of 38 mm and an overall length of 300 ml of the distilled water. Glass beads shall be used in the liquid as a bumber and to separate the specimens. After treating three test pieces in distilled water for 5 h at 100 ± 2 °C, remove the test pieces from the test liquid. Measure the thickness of each test piece as before to obtain a reliable average (T_2).

Percentage increase in thickness: $\frac{T_2 - T_1}{T_1} \times 100$

D-5.2 Weigh each test piece in air to the nearest milligram M_1. Immerse the test piece in distilled water at room temperature for 5 h. At the end of that period, withdraw the test piece from the water and wipe off all surplus water with filter paper and weigh the test piece again as M_2.

Percentage increase in mass: $\frac{M_2 - M_1}{M_1} \times 100$

ANNEX E

(*Clause* 7.7)

METHOD OF CARRYING OUT GAS PERMEABILITY TEST

E-1 PRINCIPLE

This test assesses the permeability properties of a gasket material at ambient temperature. The method indicates a measure of gas leakage through the body of the gasket.

E-2 APPARATUS

The test apparatus is as specified in Fig. 2. All parts including the test piece are centered relative to each other. Suitable measures are taken to ensure that the test piece is uniformly loaded. The surfaces of the two sealing flanges shall be machined so that the mean roughness (Rz) does not exceed 2 microns.

E-3 TEST PIECE

The specimen is of annular form with an outside diameter of mm width of mm and thickness 1.50 ± 0.15. Test specimens are stored for at least 48 h at 50 ± 6 percent relative humidity at 23 ± 2 °C.

E-4 TEST MEDIUM

Nitrogen gas with a pressure of 40 ± 1 bar.

E-5 TEST PROCEDURE

E-5.1 Place a 0.05 mm thick ring of polythene film of the same dimensions as the specimen on both sides of the specimen**.** Centre the specimen and film between the compression plates after the plates have been carefully cleaned.

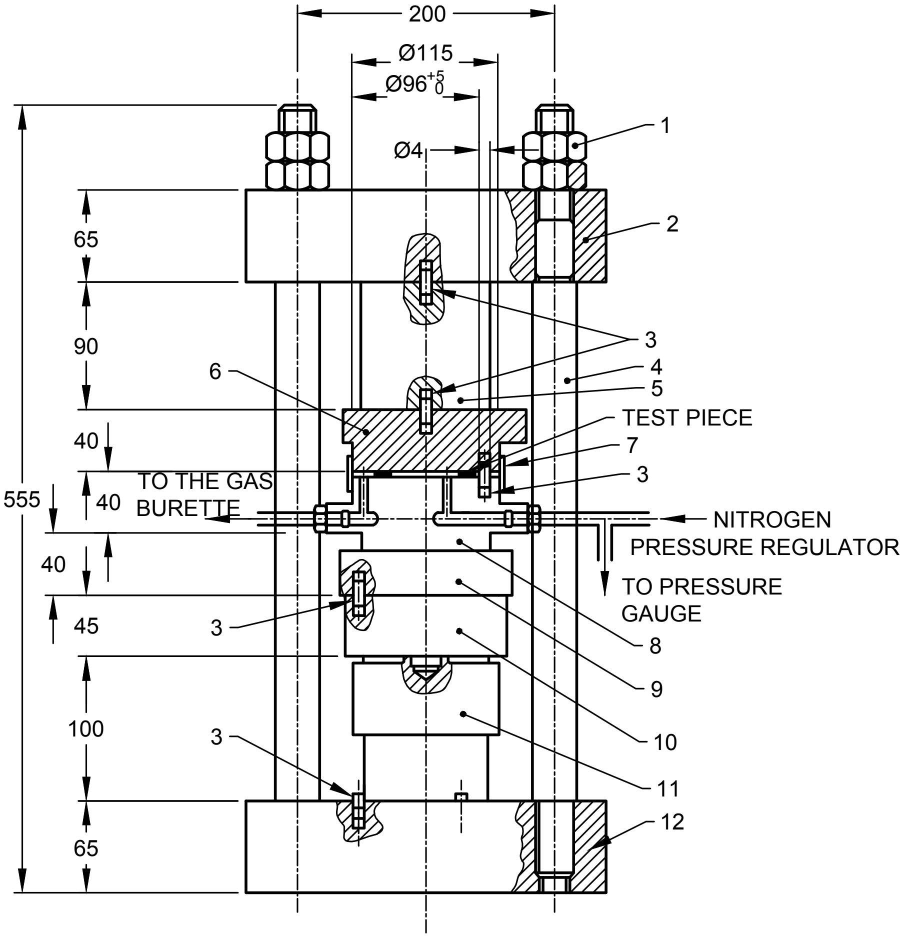
E-5.2 Load the specimen uniformly with a stress of 32 MPa.

E-5.3 After 10 min during which time, the tightness of the gas leakage measuring device is to be checked, introduce nitrogen gas inside the ring. Ensure the pressure increase is uniform and the final internal pressure is 40 ± 1 bar.

E-5.4 Hold the pressure of 40 ± 1 bar for 4 min. After a further 2 h measure the quantity of gas escaping for a period of 10 min.

E-6 TEST RESULT

Express the gas permeability in ml/min as the mean value obtained from measurements on three specimens.



Key

1 NUT
2 CROSS PIECE
3 PARALLEL PIN
4 PILLAR
5 SPACER BLOCK
6 FLANGE
7 RUBBER PACKING
8 FLANGE
9 DYNAMOMOTER WITH BALL JOINT
10 SPACER BLOCK
11 HYDRAULIC PRESS
12 BASEPLATE

All dimensions are in millimetres

FIG. 2 TYPICAL LAYOUT OF TEST APPARATUS FOR GAS PERMEABILITY

ANNEX F

(*Clause* 7.8)

METHOD OF DETERMINATION OF TENSILE STRENGTH

F-1 PRINCIPLE

The measurement of this property characterizes various classes and grades of materials of a given type.

The measurement of this property should not be misconstrued to give the purchaser of the gasket material an indication of the performance of that material in application.

F-2 APPARATUS

F-2.1 Dies

The inside faces of the dies shall be polished and be perpendicular to the plane formed by the cutting edges for a depth of at least 5 mm (0.2 inch). The dies shall be sharp and free of nicks in order to prevent ragged edges on the specimen.

F-2.2 Dial Micrometer

In accordance with the requirements of **6**.

F-2.3 Tension Testing Machine

Tension tests shall be made on a power driven machine, so equipped that a constant rate of grip separation shall be maintained, and with an indicating or recording device for measuring the resulting force within ± 2 percent. The tester shall have two grips and a mechanism for separating the grips at a uniform rate, which will be maintained during the test within ± 5 percent of the desired rate of separation. The grips shall be either wedged or toggle type, designed to transmit the applied force over a large surface area of the specimen.

F-3 TEST PIECE

The test specimens shall be 25.4 by 152.4 mm (1 by 6 inch). The lengthwise dimensions shall be perpendicular to the grain direction of the material.

F-4 PROCEDURE

F-4.1 The test shall be carried out on 8 test pieces. Each test piece shall be cut in dimensions and a manner as described in **F-2.1** and **F-3**. The test pieces should have clean and uniform cut edges. Samples with dents, uneven cuts and any other deformity shall be discarded. The test pieces shall be conditioned as described in accordance with clause **B-2**.

F-4.2 Immediately on removal from the desiccator, the thickness of each piece shall be measured with a micrometer in about four places within 50 mm on both sides of the centre. The smallest dimension shall be taken as the thickness. After measurement each test piece shall be gripped between the jaws of a suitable tensile testing machine as described in **F-2.3**, the distance between the jaws being not less than 100 mm.

The rate of transverse of the moving jaw shall be 300 ± 25 mm per min. In case the test piece breaks at the jaws, the reading should not be taken into consideration.

F-4.3 The tensile strength should be determined as breaking load/area of cross section of the test piece.

ANNEX G

(*Clause* 7.9)

METHOD FOR DETERMINATION OF LOSS ON IGNITION

G-1 PRINCIPLE

This test determines the loss in weight which represents the amount of combustibles and volatiles of the materials at various temperatures between 315 °C and 850 °C. This procedure should not be used to determine percent of binder content.

G-2 APPARATUS

G-2.1 Muffle furnace, capable of maintaining a temperature range between 315 °C and 850 °C with an accuracy of ± 5 °C.

G-2.2 Porcelain Crucible.

G-2.3 Analytical Balance.

G-2.4 Desiccator, containing anhydrous calcium chloride or silica gel.

G-3 TEST PIECE

The test pieces of approximately 2 g are conditioned in accordance with **B-2**.

G-4 TEST PROCEDURE

G-4.1 Heat a clean crucible for 30 min. at the specified test temperature. Cool to 21 to 30 °C in a desiccator. Weigh the crucible on an analytical weighing balance and record the reading W_1.

G-4.2 Place the cut or broken up a specimen in the crucible and condition in accordance with **B-2**. Weigh the specimen along with the crucible and record the weight as W_2.

G-4.3 Place the specimen and the crucible in the muffle furnace at the temperature level as determined for this test for 30 ± 1 min. Cool the specimen and the crucible to 21 to 30 °C in a desiccator. Weigh the specimen and the crucible and record the weight as W_3.

G-4.4 For the test at 850 °C the specimen should be ignited initially in the crucible by supporting over a flame in an exhausted hood until the sample has been extinguished.

G-5 CALCULATION

The loss on ignition is calculated as follows:

$$L = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

where

L = loss of ignition percent;

W_1 = weight of empty crucible;

W_2 = weight of test piece and the crucible after conditioning; and

W_3 = weight of test piece and crucible after ignition.

ANNEX H

(*Foreword*)

COMMITTEE COMPOSITION

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